ROYAL INSTITUTION OF GREAT BRITAIN.

April 20, 1855.—William Robert Grove, Esq., M.A., Q.C., F.R.S., Vice-President, in the Chair.

On certain Zoological Arguments commonly adduced in favour of the hypothesis of the Progressive Development of Animal Life in Time. By T. H. Huxley, Esq., F.R.S.

When the fact that fossilized animal forms are no *lusus naturæ*, but are truly the remains of ancient living worlds, was once fully admitted, it became a highly interesting problem to determine what relation these ancient forms of life bore to those now in existence.

The general result of inquiries made in this direction is, that the further we go back in time, the more different are the forms of life from those which now inhabit the globe, though this rule is by no means without exceptions. Admitting the difference, however, the next question is, what is its amount? Now it appears, that while the Palæozoic *species* are probably always distinct from the modern, and the *genera* are very commonly so, the *orders* are but rarely different, and the great *classes* and *sub-kingdoms* never. In all past time we find no animal about whose proper sub-kingdom, whether that of the *Protozoa, Radiata, Annulosa, Mollusca,* and *Vertebrata,* there can be the slightest doubt; and these great divisions are those which we have represented at the present day.

In the same way, if we consider the Classes, *e. g. Mammalia, Aves, Insecta, Cephalopoda, Actinozoa,* &c., we find absolutely no remains which lead us to establish a class type distinct from those now existing, and it is only when we descend to groups having the rank of Orders that we meet with types which no longer possess any living representatives. It is curious to remark again, that, notwithstanding the enormous lapse of time of which we possess authentic records, the extinct ordinal types are exceedingly few, and more than half of them belong to the same class—*Reptilia.*

The extinct ordinal Reptilian types are those of the *Pachypoda, Pterodactyla, Enaliosaurea,* and *Labyrinthodonta*; nor are we at present acquainted with any other extinct order of Vertebrata. Among the *Annulosa* (including in this division the *Echinodermata*) we find two extinct ordinal types only, the *Trilobita* and the *Cystideæ.*

Among the *Mollusca* there is absolutely *no* extinct ordinal type; nor among the *Radiata* (*Actinozoa* and *Hydrozoa*); nor is there any among the *Protozoa.*

The naturalist who takes a wide view of fossil forms, in connection with existing life, can hardly recognize in these results anything but strong evidence in favour of the belief that a general uniformity has prevailed among the operations of Nature, through all time of which we have any record.

Nevertheless, whatever the amount of the difference, and however one may be inclined to estimate its value, there is no doubt that the

living beings of the past differed from those of the present period; and again, that those of each great epoch have differed from those which preceded and from those which followed them. That there has been a succession of living forms in time, in fact, is admitted by all; but to the inquiry—What is the law of that succession? different answers are given; one school affirming that the law is known, the other that it is for the present undiscovered.

According to the affirmative doctrine, commonly called the theory of Progressive Development, the history of life, as a whole, in the past, is analogous to the history of each individual life in the present; and as the law of progress of every living creature now, is from a less perfect to a more perfect, from a less complex to a more complex state—so the law of progress of living nature in the past, was of the same nature; and the earlier forms of life were less complex, more embryonic, than the later. In the general mind this theory finds ready acceptance, from its falling in with the popular notion, that one of the lower animals, *e. g.* a fish, is a higher one, *e. g.* a mammal, arrested in development; that it is, as it were, less trouble to make a fish than a mammal: but the speaker pointed out the extreme fallacy of this notion; the real law of development being, that the progress of a higher animal in development is not through the forms of the lower, but through forms which are common to both lower and higher: a fish, for instance, deviating as widely from the common Vertebrate plan as a mammal.

The Progression theory, however, after all, resolves itself very nearly into a question of the structure of fish-tails. If, in fact, we enumerate the oldest known undoubted animal remains, we find them to be *Graptolites*, *Lingulæ*, *Phyllopoda*, *Trilobites*, and *Cartilaginous fishes*.

The *Graptolites*, whether we regard them as *Hydrozoa*, *Anthozoa*, or *Polyzoa* (and the recent discoveries of Mr. Logan would strongly favour the opinion that they belong to the last division), are certainly in no respect embryonic forms. Nor have any traces of *Spongiadæ* or *Foraminifera* (creatures unquestionably far below them in organization) been yet found in the same or contemporaneous beds. *Lingulæ*, again, are very aberrant *Brachiopoda*, in nowise comparable to the embryonic forms of any mollusk; *Phyllopods* are the highest *Entomostraca*; and the *Hymenocaris vermicauda* discovered by Mr. Salter in the Lingula beds, is closely allied to *Nebalia*, the highest Phyllopod and that which approaches most nearly to the *Podopthalmia*. And just as *Hymenocaris* stands between the other *Entomostraca* and the *Podopthalmia*, so the *Trilobita* stand between the *Entomostraca* and the *Edriopthalmia*. Nor can anything be less founded than the comparison of the *Trilobita* with embryonic forms of *Crustacea*; the early development of the ventral surface and its appendages being characteristic of the latter, while it is precisely these parts which have not yet been discovered in the *Trilobita*, the dorsal surface, last formed in order of development, being extremely well developed.

The *Invertebrata* of the earliest period, then, afford no ground for the Progressionist doctrine. Do the Vertebrata?

These are cartilaginous fish. Now Mr. Huxley pointed out that it is admitted on all sides that the brain, organs of sense, and reproductive apparatus are much more highly developed in these fishes than any others; and he quoted the authority of Prof. Owen *, to the effect that no great weight is to be placed upon the cartilaginous nature of the skeleton as an embryonic character. There remained, therefore, only the heterocercality of the tail, upon which so much stress has been laid by Prof. Agassiz. The argument made use of by this philosopher may be thus shortly stated:—Homocercal fishes have in their embryonic state heterocercal tails; therefore, heterocercality is, so far, a mark of an embryonic state as compared with homocercality; and the earlier, heterocercal fish are embryonic as compared with the later, homocercal.

The whole of this argument was based upon M. Vogt's examination of the development of the *Coregonus*, one of the *Salmonidæ*; the tail of *Coregonus* being found to pass through a so-called heterocercal state in its passage to its perfect form †. For the argument to have any validity, however, two conditions are necessary:—1. That the tails of the *Salmonidæ* should be homocercal, in the same sense as those of other homocercal fish. 2. That they should be really heterocercal, and not homocercal, in their earliest condition. On examination, however, it turns out that neither of these conditions hold good. In the first place, the tails of the *Salmonidæ*, and very probably of all the *Physostomi*, are not homocercal at all, but to all intents and purposes intensely heterocercal; the chorda dorsalis in the Salmon, for instance, stretching far into the upper lobe of the tail. The wide difference of this structure from true homocercality is at once obvious, if the tails of the *Salmonidæ* be compared with those of *Scomber scombrus*, *Gadus æglefinus*, &c. In the latter, the tail is truly homocercal, the rays of the caudal fin being arranged symmetrically above and below the axis of the spinal column.

All M. Vogt's evidence, therefore, goes to show merely that a *heterocercal* fish is heterocercal at a given period of embryonic life; and in no way affects the truly homocercal fishes.

In the second place, it appears to have been forgotten that, as M. Vogt's own excellent observations abundantly demonstrate, this heterocercal state of the tail is a comparatively late one in *Coregonus*, and that, at first, the tail is perfectly symmetrical, *i. e.* homocercal.

In fact, all the evidence on fish development which we possess, is to the effect that Homocercality is the younger, Heterocercality the more advanced condition: a result which is diametrically opposed to that which has so long passed current, but which is in perfect accordance with the ordinary laws of development; the asymmetri-

* Lectures on the Comparative Anatomy of the Vertebrata, pp. 146–7.

† Von Bär had already pointed out this circumstance in *Cyprinus*, and the relation of the fœtal tail to the permanent condition in cartilaginous fishes. See his "Entwickelungsgeschichte der Fische," p. 36.

cal being, as a rule, subsequent in the order of development to the symmetrical.

The speaker then concluded by observing that a careful consideration of the facts of Palæontology seemed to lead to these results:—

1. That there is no real parallel between the successive forms assumed in the development of the life of the individual at present, and those which have appeared at different epochs in the past; and

2. That the particular argument supposed to be deduced from the heterocercality of the ancient fishes is based on an error, the evidence from this source, if worth anything, tending in the opposite direction.

At the same time, while freely criticising what he considered to be a fallacious doctrine, Mr. Huxley expressly disclaimed the slightest intention of desiring to depreciate the brilliant services which its original propounder had rendered to science.

BOTANICAL SOCIETY OF EDINBURGH.

April 12, 1855.—Professor Balfour, President, in the Chair.

The following papers were read:—

1. "On Placentation," by John Cleland, Esq. See 'Annals,' vol. xv. p. 336.

2. "Notes on the Flora of the neighbourhood of Castle Taylor, in the county of Galway," by A. G. More, Esq., of Trinity College, Cambridge.

The author enters into a detailed account of the indigenous flora of that part of Ireland, contrasting it with that of other parts of the United Kingdom. The district is rendered interesting from its forming part of the singular limestone-country of the West of Ireland, the surface broken and rocky, and but slightly elevated above the sea-level: nevertheless several subalpine species are to be found in it, such as *Dryas octopetala*, *Saxifraga hypnoides*, *Hieracium cerinthoides*, *Arbutus Uva-ursi*, *Juniperus nana*.

He then arranges the produce of his district and the classes defined by Watson, and enumerates the more interesting or peculiar plants present or absent in each case. He points out the following species as seen by him, but not marked as Irish in 'Babington's Manual':—

Cardamine sylvatica.	Hieracium cerinthoides.
Viola stagnina.	Epipactis media.
Spiræa filipendula.	Potamogeton lanceolatus.
Geum intermedium.	Alopecurus agrestis.
Myriophyllum alterniflorum.	Lolium italicum.

3. "Notes on the Flora of the Bass Rock," by Prof. Balfour.

4. "Notice of Plants collected during a trip to Loch Lomond in July 1854," by Prof. Balfour.

5 "Register of the Flowering of Spring Plants in the Royal Botanic Garden, as compared with the four previous years," by Mr. M'Nab.